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Title of the Invention

WAFER PEDESTAL TILT MECHANISM AND COOLING SYSTEM

Field of the Invention

The invention relates generally to ion implanters for the manufacture of semiconductor wafers, and more particularly to pedestals and wafer cooling systems for ion implanters.

Background of the Invention

Ion implanters are used to introduce conductivity-altering impurities into semiconductor wafers. In order to accomplish this, the desired impurity material is ionized via an ion source, and then accelerated to form an ion beam of prescribed energy. The ion beam is then directed at the surface of the semiconductor wafer so that the ions in the beam penetrate the semiconductor material and are embedded in the crystalline lattice thereby forming a region of desired conductivity.

In semiconductor wafer manufacturing, there are several important considerations in achieving an effective ion implanter. One important factor is throughput, or the number of wafers processed per time unit. In addition, wafer transfer time, ion implant time and down time are other important considerations. Another important factor is the ability to implant at high angle tilt. A high tilt angle, generally in the range of about 20 to about 60 degrees, allows doping of the silicon structure beneath an obstruction to the beam. Another important consideration is the ability to cool the wafers without resulting in a rotating unbalanced condition. This condition can occur when all of the pedestals do not move into position at the same time resulting in the coolant creating an unbalanced load. Thus, an ion implanter system capable of high wafer throughput, uniform dose with the capability of high tilt angle implantation and wafer cooling is desired.

Summary of the Invention

The invention provides in one aspect a wafer pad assembly for mounting and cooling a wafer and being disposed in an ion implanter. The wafer pad assembly comprises a wafer support pad having an upper surface for mounting the wafer and a lower surface. The lower surface of said wafer support pad is connected to a coolant passage having an inlet section and an outlet section arranged in an opposed

configuration, wherein said inlet section is counterbalanced by said outlet section.

The invention provides in another aspect a wafer pad assembly for mounting a wafer and being disposed in an ion implanter. The wafer pad assembly comprises a wafer support pad having an upper surface for mounting the wafer and a lower surface that encloses the coolant passages. The lower surface is connected to a frame having an outer curved surface in mating engagement with a complementary shaped bearing surface of a housing wherein said wafer can be rotated about the axis of the centerline of the wafer mounted on the pad.

These and other aspects and advantages of the present invention will be readily understood and appreciated by those skilled in the art from the following detailed description of the preferred embodiments with the best mode contemplated for practicing the invention in view of the accompanying drawings.

Brief Description of the Figures

Figure 1 is a plan view of an ion implantation system;

Figure 2 is a side view of a wafer pedestal assembly and cooling system of the present invention;

Figure 3 is a top view of the wafer pedestal assembly shown in Figure 2;

Figure 4 is a front view of the wafer pedestal assembly and cooling system of the invention shown in Figure 2;

Figure 5 is a top view of the cooling passages of the wafer pedestal assembly shown in Figure 4;

Figure 6 is a side view of a wafer pedestal assembly and cooling system of the present invention shown in a tilted position; and

Figure 7 is a perspective side view of the wafer pedestal assemblies mounted upon a disk of a batch type ion implanter.

Detailed Description of the Invention

Referring now to the drawings, Figure 1 discloses an ion implanter, generally designated at 10, which comprises a terminal 12, a beamline assembly 14, and an end

station 16. Generally, the terminal 12 outputs an ion beam, and the beamline assembly 14 adjusts the focus, ion species and energy level of the ion beam and directs it toward a wafer W positioned at the end station 16.

The terminal 12 includes an ion source 18 having a chamber in which dopant gas from a gas box 20 is injected. Energy is imparted to the ionizable dopant gas to generate positive ions within the source chamber. An extraction electrode 22 powered by high voltage supply 24 extracts a beam 26 of positive ions from the source chamber and accelerates the extracted ions toward a mass analysis magnet 28. The mass analysis magnet 28 functions to pass only ions of an appropriate charge-to-mass ratio on to the beamline assembly 14. Evacuation of the beam path 29 provided by the mass analysis magnet 28 is provided by vacuum pump 30.

The beamline assembly 14 comprises a quadrature lens 32, a flag Faraday 34, an electron shower 36, and optionally an ion beam acceleration\deacceleration electrode (not shown). The quadrature lens 32 focuses the ion beam output by the terminal 12 and the flag Faraday 34 measures ion beam characteristics during system setup. The optional acceleration\deacceleration electrode may be used to accelerate or deaccelerate the focused ion beam to a desired energy level prior to implantation into a wafer at the end station 16. Evacuation of the beam path provided by the beamline assembly 14 is provided by vacuum pump 38.

The end station 16 includes a disk 40 upon which a plurality of wafers W are mounted. A rotary disk drive mechanism 42 is provided for imparting rotational motion to the disk, and a linear drive mechanism 44 is also provided for imparting linear motion to the disk. A robotic arm 46 loads wafers W onto the disk 40 via a load lock chamber 48. Operation of the system is controlled by an operator control station 50 located at the end of the end station 16.

As shown in Figure 2, each wafer W is mounted to the wafer pad assembly 100 of the present invention. The wafer pad assembly, shown generally at 100, provides for high angle tilting in the range of about zero to about 45 degrees of each individual wafer W. Tilting is defined as the rotation of the wafer W about the z axis, of the x,y,z coordinate system of the wafer pad assembly 100 as shown in Figure 6. Preferably, the geometric centers of each wafer W is aligned with the Z axis so that each wafer is tilted about its geometric center.